REMARKS/ARGUMENTS

Overview of the invention :

The invention discloses a liftoff resist formed from a single material and a method to manufacture it. Conventional photoresist (positive or negative) is patterned in the conventional way. Then, the top surface (only) is exposed to a beam of ions **whose energy is too low to cause sputtering**. Said ions penetrate a short distance beneath the photoresist surface, forming there a hardened layer. This is followed by exposure to ozone which erodes all exposed photoresist surfaces except the aforementioned hardened layer, causing the **latter to overhang the unhardened layer beneath it**, thereby rendering it suitable for subsequent use as a liftoff resist.

Reconsideration is requested of the rejection of claims 7 and 9 based on 35 U.S.C. 112:

The typographical errors (% instead of °) in claims 7 and 9 have been corrected.

Reconsideration is requested of the rejection of claims 32, and 34-35 under 35 U.S.C. 102, as being anticipated by Yamada et al. in US 4,904,619 (col. 3 lines 29-64, col. 4 lines 63-68, col. 5 lines 1-13, and figure 1a through figure 1d):

Examiner states that Yamada discloses a photoresist pattern suitable for liftoff, having sidewalls and an upper surface ... such that the bottom portion (shadowed region) of the resist pattern remains unhardened.

Since our claim 32 is a structures claim, we have omitted, from the above summary of examiner's argument. reference to how Yamada's photoresist pattern was formed.

Our claim 32 (as currently amended) reads as follows:

32. A photoresist pattern suitable for liftoff, comprising;

a single photoresist layer;

said single photoresist layer further consisting of an upper portion that is resistant to chemical attack and a lower portion that is susceptible to chemical attack; and

said upper portion overhanging said lower portion by between about 0.01 and 0.1 microns on each side.

It is unclear why examiner cites Yamada's figure 1(d) since it shows no photoresist. Nor is it clear what examiner means by the "shadowed portion" since all photoresist shown in figures 1 (a) -1(c) is uniformly hatched and Yamada makes no mention of a shadowed portion.

Examiner rejects our claim 35 (now incorporated into claim 32) arguing that "Yamada, in col. 5 lines 10-12, discloses that the hardened layer (unetched overhang) overhangs the shrunk bottom resist by about 0.1 μ ... on each side (claim 35). This is not, however, what Yamada says. The cited col. 5 lines 10-12 read as follows: "After treatment, the resist pattern is given an inverted trapezoidal shape with the bottom width about 200 nm shorter than the top width". In other words, it is NOT a hardened layer that overhangs the resist below it, but rather it is the entire resist that reduces its width uniformly over its entire length by about 200 nm. This is not the structure that we describe in our claim 32.

Reconsideration is requested of the rejection of claims 1-2, 5-6, and 8 under 35 U.S.C. 103, as being unpatentable over Yamada et al. in US 4,904,619 in view of Bloomstein et al. in US 6.833.234.

Examiner quotes Yamada (col. 3 lines 29-64, col. 4 lines 63-68, col. 5 lines 1-13, and figures 1(a) through 1(d) as teaching "... performing an ion beam irradiation so as to cause hardening of the resist surface on the top portion (upper surface hardened) of the resist pattern that is resistant to chemical attack (i.e the ion beam irradiation or sputter cleaning is too weak to etch the resist pattern surface) such that the bottom portion (shadowed region) of the resist pattern remains unhardened,..."

This is NOT what Yamada states in the quoted sections. While Yamada teaches hardening of the resist top portion surface he also teaches doing so "by sputter etching using oxygen gas...". In particular, examiner's parenthetical statement that "the ion beam irradiation or sputter cleaning is too weak to etch the resist pattern surface" originates with examiner, not with Yamada. Nor would we expect Yamada to make such a statement since it is incorrect.

In several previous responses to rejections by examiner we have pointed out each time that whether or not material is removal during the hardening process is the fundamental difference between Yamada and the present invention. By keeping the impinging ion energy too low for sputtering the present invention achieves hardening without removing any resist while Yamada, by virtue of the fact that he is using sputter etching, must remove material. Examiner has not responded to this key argument each time that we have made it but has simply restated her original reasons for rejection.

It occurs to us that examiner is under the impression that during sputter cleaning or sputter etching no material is removed. If this is examiner's impression of what sputter cleaning is we respectfully refer her to her choice of any one of the many manuals on semiconductor processing that are available. Or, should examiner prefer,

we invite her to read the specifications for a standard commercial sputter cleaner, such as Omicron's ISE 10, where she will see that the minimum ion energy available from such equipment is about 200 volts.

Examiner's additional reliance on Bloomstein et al. for this rejection is for the purposes of arguing that exposure of a resist to ozone is equivalent to exposing it oxygen. While we note, without prejudice, that ozone is both more effective and more expensive than oxygen, for ashing purposes, we believe that, in view of the arguments presented above with regard to Yamada, our claims 1-2, 5-6, and 8 are now allowable.

In rebutting our argument, (presented as part of our response dated 02/15/2007) that Yamada does not teach an ion beam voltage of about 200 volts (claimed range), examiner states that Yamada "is depended upon to disclose the claimed ion beam energy of about 100 volts. See paragraph no. " (sic). Since we cannot respond to this unless examiner provides us with the paragraph no. in question, we respectfully request that she do so in the form of another, non-final, rejection or that she abandon this part of her argument.

In summary, Yamada teaches a method to manufacture a liftoff resist that includes high energy sputtering. This results in a resist having a trapezoidal cross-section. Yamaha sputters away some of the material as it is being hardened. The present invention teaches use of a low energy ion beam to harden the resist surface, with no material being removed during the hardening process, followed by shrinkage of the unhardened portion by exposing it to ozone.

In view of the arguments presented above, applicants respectfully contend that neither Yamada, nor Yamada in combination with Bloomstein, teaches or suggests the claimed invention and therefore respectfully request that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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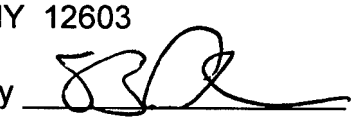
By 

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